Paper / Subject Code: 32306 / Elective - I Digital Control System

Friday, May 31, 2019   02:30 pm - 05:30 pm   1T01125 - T.E.(ELECTRONICS)(Sem V)(Choice Based) / 32306 - Elective I: Digital Control System   71008 (3 hours)   [Total Marks: 80]
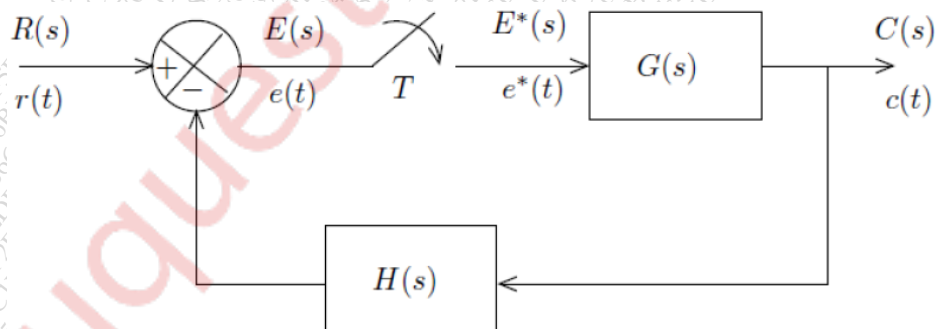
Note:

1. Question-1 is compulsory.

2. Answer any three questions from remaining five.

3. Assume suitable data if necessary.

4. Numbers in the right indicate marks.

1.   Answer any four of the following questions. (Each question carry 5   20
      marks)

   (a) Derive the relationship between discrete state space model and pulse
       transfer function.

   (b) What is an observer? Why is it required?

   (c) What are the advantages of state variable method for analysis of digital
       control system?

   (d) State and explain Jury's stability criterion.

   (e) Is it possible for an unobservable system to be detectable? Justify your
       answer.

2. (a) Obtain the closed loop transfer function for the following system   10
       G(s) = 1/s(s+1), H(s) = 1

   (b) Derive the relation between s plane and z plane using Bilinear   10
       Transformation technique.

3. (a) For the given system obtain the state transmission matrix using Cayley-   10
       Hamilton method

$$x[k + 1] = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x[k] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u[k]$$

$$y[k] = [1 \quad 0]x[k], \qquad x[0] = [1 \quad 1]^T$$

(b) Consider the following system   10

$$\frac{Y(z)}{U(z)} = \frac{z+1}{z^2 + 1.3z + 0.4}$$

Represent the system in controllable canonical form, observable canonical form and diagonal canonical form.

4. (a) Investigate the controllability and observability for the following system   10

$$x[k+1] = \begin{bmatrix} 0 & 1 \\ -0.4 & -1.3 \end{bmatrix} x[k] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u[k]$$

$$y[k] = [0.8 \quad 10]x[k]$$

(b) State and prove the Nyquist sampling theorem.   10

5. (a) Show that the following system is not completely observable   10

$$x[k+1] = Gx[k] + Hu[k]$$
$$y[k] = Cx[k]$$

where, $G = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$, $H = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $C = [4 \quad 5 \quad 1]$

(b) Obtain the block diagram for the following pulse transfer function by 1) direct programming 2) standard programming 3) ladder programming   10

$$\frac{Y(z)}{U(z)} = \frac{2 - 0.6z^{-1}}{1 + 0.5z^{-1}}$$

6. Answer any two of the following questions.   20

(a) Distinguish between reachability and controllability in discrete time systems.

(b) Explain dead beat control using state feedback.

(c) Write short note on state observer based controller design.

(d) Digital PID controller.

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